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ABSTRACT

The Stanford Achievement Test was administered to 2,186 of the 47,045 Montana high school students to analyze whether or not school size is important in determining student achievement, and to analyze factors that affect student achievement and whether those factors vary by school size. The sample included 1,311 sophomores and 875 seniors. To accomplish the first objective, the mean score of each test was calculated for each school, and the score was standardized so that a composite total score could be calculated. The procedure was the same for all respondents. Regression analysis was used to analyze the data for the second objective. Twelve variables were chosen to represent the school, the student, and the student's socio-economic status. The independent variables were regressed against each of the dependent variables for each of four school size categories and for all students sampled. Results indicated that, at the senior level, no significant differences existed in the mean test scores based on school size. However, sophomores of the larger schools scored better than did those from smaller rural schools. Different variables influenced student achievement in the rural schools than in larger urban schools. Students' socio-economic backgrounds had the most influence on their achievement. (CM)

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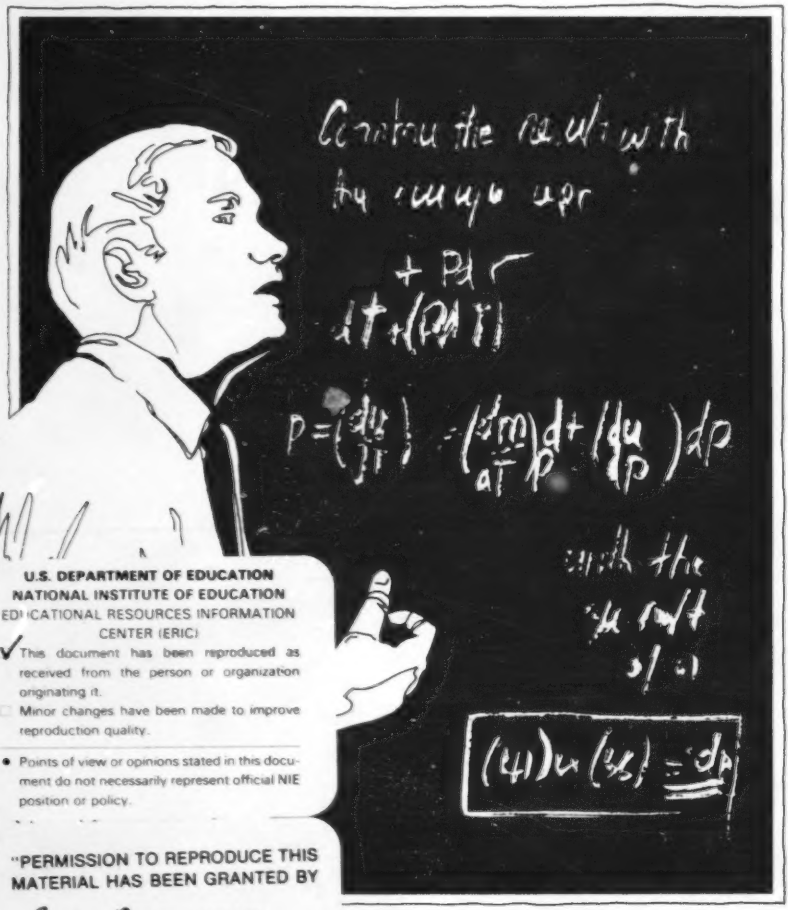
Basic Quality of Secondary Education in Rural Montana

Montana Agricultural Experiment Station
Montana State University, Bozeman



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Basic Quality of Secondary Education in Rural Montana

*John W. Kimble, Gail L. Cramer and Verne W. House**

Introduction

A casual review of educational statistics suggests that Montanans compare favorably to the nation. For example, the 1970 census shows median number of years of school for Montanans 25 years and older to be 12.4 in urban areas, 12.2 for rural farm population, and 12.1 for rural non-farm population. Nationally, the urban median is 12.2 years for the urban populace and 11.1 for rural. This comparison shows Montanans to have attended school longer than typical U.S. citizens and suggests the urban-rural difference is smaller here.

A closer look at the distribution of people with at least four years of college shows Montana to differ sharply from the nation. In Montana, 13.6 per cent of urban and 6.4 per cent of rural people have four or more years of college. Nationally, the percentages are 10.7 urban and 6.7 rural (Commerce, 1970).

Has the educational system shortchanged rural people? The fact that rural Montanans typically have less education than urban Montanans does not in itself indicate that rural schools are inferior to urban schools. Indeed, many products of rural schools now reside in urban areas. Besides, the amount of schooling is not considered as essential to many rural employment opportunities in agriculture, mining and forestry as it is to urban opportunities.

Low levels of educational achievement by rural youth may be indicative of a poor quality of education (Coleman, 1966). While data indicate that rural youth are getting a better education than their parents, they still lag behind their urban counterparts. Rural students drop out of school at an earlier age and fewer rural students go on to college. Those rural students who do go on to school have a hard time competing with the urban student (U.S. Commission of Rural Poverty, 1967: 41-44).

The various components of an educational system, including teachers, buildings, facilities, curriculum, and programs, are usually of lower quality in rural districts than in urban schools. Low teacher salaries and poor facilities in rural schools do not attract or retain the better teachers. In general, small schools lack the equipment that the large urban schools can afford. Furthermore, students who live in rural areas are hampered by geographic isolation and what is called "small town milieu" (Sweeney, 1971: 4-8). These limitations may inhibit them from acquiring the behavior patterns necessary for coping with urban

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living. The Coleman Report (a recent study which hypothesizes that rural students are getting short-changed educationally) concluded that the low educational level of the parents and a combination of community factors place rural students at a disadvantage even at the time they enter school.

The majority of Montana's high schools, about 65 percent, have less than 180 students. These schools account for 20 percent of the total number of high school students in the state. Sixteen of Montana's largest urban high schools have approximately 50 percent of the student enrollment. In 1974 Montana's expenditures were about $1109 per pupil in average daily attendance. In 1972, Montana spent 52.18 cents of every tax dollar on education (Montana, 1972: I, 1,V.1). In Fiscal Year 70-71, 73 percent of school funds came from the local level, 21 percent from the state, and 6 percent from the U.S. government (Montana Schools, 1972: I.1). These figures have not varied by more than 2 percent in the past 10 years. This large tax burden carried by the local taxpayer can cause inequities in school quality. Because of the spillover of educational benefits to areas outside the local school district, emphasis has been placed on supporting school systems through a broader tax base.

The problems of rural schools and the costs of schooling have made the issues of school efficiency, school quality, and educational quality of interest to nearly every citizen. In the last decade, rising costs and increasing taxes have aroused the public's interest in the economics of schools. Accountability and efficiency have become key educational issues. The problems of education require much knowledge about the educational process and educational outcomes.

Education is "free" to students but in an economic sense, education is not a free good. The resources used (buildings, money, people) in its production could be used to produce other goods. Because there are alternative uses for these resources, education may be evaluated by the traditional tests of economic logic—efficiency and the distribution of benefits and costs.

Education consists of two major economic components, investment and consumption. The investment component refers to future years of increased earning power. The consumption component includes the immediate utility and long-run satisfaction of education for the individual. These benefits accrue directly to the student and his family and are personal outcomes. The amount a student or his parents spend on education tends to be determined by his estimated benefits from increased productivity and enjoyment. Thus, the student would be expected to spend an amount on education that would equate private marginal benefits to private marginal costs.

As an economic good, education contributes to society as well as the individual. This is sometimes called the "spillover effect"

and it has two important implications.[1] One is that the costs should be borne by those who benefit from education; another is that efficiency in resource allocation suggests that the amount of education provided will be less than optimal if the external benefits are not considered. Making education socially efficient and equitable requires that the cost burden be adjusted. Expenditures must be extended beyond the point where private marginal costs equal private marginal benefits so that ultimately private marginal costs plus external marginal costs equal private marginal benefits plus external marginal benefits; also some means of allocating the costs to the proper private and public beneficiaries must be considered.[2]

This report describes the economics of what is put into Montana schools (resources) compared to what comes out (educational achievement). In this analysis we assume that the school functions somewhat like a firm in the sense that it tends to do the best it can within its resource limitations. In other words, there are resource-output relationships that approximate an educational production function. Educational production can be depicted as a functional relationship which illustrates the maximum amount of educational output that could be produced by each and every set of inputs.

The research reported here has two major objectives:

1. to analyze whether school size is important in determining student achievement, and

2. to analyze factors that affect student achievement and to ascertain whether these factors vary by school size.

The findings have important implications for school funding priorities.

Overview of Testing

Because we are interested in the economic consequences of schooling, our output measures ideally should concern socio-economic behavior following the termination of schooling. Such measures are difficult to obtain. Characteristically, we are forced to use indices of achievement based on tests administered while the student is still enrolled. These scores can be considered as proxies for post-school behavior.

The achievement test used in the study was the Stanford Achievement Test (SAT), High School Battery. Three of the tests were used — English, numerical competency, and reading. Two individuals were hired to administer the tests. One was certified to teach mathematics at the secondary school level but had no teaching experience. The other was a certified elementary teacher with eight years teaching experience and a master's degree in education. The tests were administered according

[1] In economic parlance, spillover effects are often called "externalities."

[2] Educational costs can be further divided into private and public costs. Private or individual costs include indirect costs such as earnings foregone while in school and direct costs such as tuition, books and supplies. Public cost includes the cost of building and operating schools.

to the instructions provided by the test company and were scored by the Test Scoring Service Department at Montana State University.

The tests are designed to measure the educational achievement of students in school. It takes 40 minutes to administer each of the three tests. The English test consisted of three parts while the numerical competency and reading tests were composed of a single section each. In order to establish norms and a basis for standardization, the test was administered to 22,699 students on a regional basis. For each student the raw scores were converted to a standard score and then translated to either a percentile rank or stanine or both. The Stanford Achievement Test manual provided the necessary information for this process of standardization. The standard score has a median of 50 and a standard deviation of 10 with a normal distribution. This standardization process is different for each grade or class. Percentile rank allows the student's performance to be compared with the norm group. For example, a percentile score of 60 would mean the student was equal to or greater than 60 percent of the other students in his group. The stanine is a value which is represented on a simple nine-point scale of normalized scores range from a low of 1 to a high of 9 with the value of 5 always representing the average performance for students in the norm group. Specific information on the test may be obtained from the SAT manual (Gardner, 1965).

The Student Sample

The manner in which the schools and the individual students were chosen is described below. All public high schools in Montana were arranged from largest to smallest according to the enrollment of the school. Statistics (Montana, 1972) from the Office of the Superintendent of Public Instruction for 1972 showed 47,045 high school students in 167 operating high schools. These schools were then divided into 10 groups with roughly 10 percent of the total students in each (Table 1). Five percent of all high school students were to be tested. The method of selection varied because of the number of schools in each of the size categories. Schools that fell in the first three size categories were chosen at random until the approximate predetermined number of sample students was obtained. In size categories four, five, six, seven and eight, the sample schools were chosen at random and in most cases the sample of students within schools was picked at random. In the largest categories, a sample of students was taken from all the schools to obtain the desired number. This procedure left 30 schools. Three of the 30 declined participation in the survey. The size of two of these schools placed them in a category which allowed no substitutes.

Testing dates were arranged with each of the schools. A breakdown of students tested is shown in Table 2. It will be noted that discrepancies appear between the planned and actual testing. In some cases the schools requested the tests be administered to the total

TABLE 1. SAMPLING BREAKDOWN OF MONTANA SCHOOLS BY SIZE

	Size	No. of Schools	No. of Students	Approx. No. of Students to Test	No. of Schools	Percent of Students to Test
1.	0- 117	74	4,952	260	7	100
2.	119- 180	33	4,867	270	4	100
3.	181- 261	23	4,890	340	3	100
4.	272- 470	12	4,373	300	3	50
5.	473- 621	9	4,694	260	3	30
6.	639-1,040	6	4,748	260	2	30
7.	1,207-1,677	3	4,452	260	2	16
8.	1,815-1,905	3	5,575	240	2	9
9.	1,936-2,040	2	3,976	300	2	12
10.	2,247-2,271	2	4,518	330	2	11
		167	47,045	2,820	30	

population, rather than to a sample. Absences and limitations set by the school administrators also contributed to the discrepancies. Some schools asked that grades nine and eleven be tested at the same time as the tenth and twelfth grades. Figures for the ninth and eleventh grades tested were not included in Table 2.

Protection of student anonymity was a slight problem during data collection. In order to return test results to the schools, the project leaders agreed to supply to each school a label with student identification and the test scores. Each test answer sheet was pre-numbered before the project began. The respondents in grade twelve transferred this number to the questionnaire and it was the only item entered into the project data files as a means of student identification.

The method of selecting a sample of students in individual schools varied. In some cases, particular classes thought to be representative of the students were chosen. In some schools, the sample was taken from alphabetical lists or by random selection from another file source. Two schools utilized a computer to draw their sample. One school agreed to participate in the project on the condition that student participation be on a volunteer basis. In this instance, project representatives met with the students, explained the project and asked for their participation. Another school agreed to participate only on the condition that school personnel administer the test. A small number of completed tests (less than 10) were discarded because of responses that did not make sense.

TABLE 2. ACTUAL STUDENT SAMPLE FOR GRADES 10 AND 12.

	Size	Total No. of Students Tested	Number of 10th Graders Tested	Number of 12th Graders Tested
1.	0- 117	256	132	124
2.	119- 180	193	127	66
3.	181- 261	237	138	99
4.	272- 470	548	348	200
5.	473- 621[a]	182	104	78
6.	639-1,040	240	132	108
7.	1,207-1,677	197	128	69
8.	1,815-1,905	164	97	67
9.	1,936-2,040	169	105	64
10.	2,247-2,271[b]			
	TOTALS	2,186	1,311	875

[a]One school declined to participate.
[b]Both schools declined to participate.

Senior and Sophomore Test Scores

The mean scores for sophomores and seniors by school are presented in Tables 3 and 4. The scores are standardized by the process discussed earlier.

The same scores are ranked from high to low in Tables 5 and 6. According to these data, the schools perform fairly consistently across the three subject areas. The schools are numbered from 1 to 27 according to their size (1 is small and 27 is large).

After the raw test scores were converted to standardized scores, the mean scores for each school were compared for each test. The results of an analysis of variance procedure which was used to test the hypothesis of equal means for all schools for each test are shown in Tables 7 and 8. Each table includes the overall mean for the test, the calculated F-value for both seniors and sophomores. As shown in the table, the F-value in each case has a significance level of .01 which indicates that the hypothesis that all means are equal does not hold true here. Thus, it must be concluded that the students at the various high schools in the state performed statistically different on the achievement tests.

TABLE 3. MEAN STANDARD SCORES FOR SENIOR STUDENTS BY SCHOOL.

School Number	English	Reading	Numerical	Total*
1	46.4	44.6	46.6	137.6
2	50.0	50.5	52.8	153.2
3	56.6	55.2	56.2	167.9
4	49.6	48.5	50.3	148.5
5	50.4	50.4	49.5	150.2
6	52.8	51.4	57.9	162.1
7	45.5	42.0	45.4	133.0
8	55.6	52.4	52.1	160.1
9	57.8	57.6	56.9	172.4
10	44.6	44.1	44.5	133.2
11	56.8	57.4	53.7	167.8
12	50.8	53.4	53.4	157.6
13	46.3	48.8	47.1	142.2
14	50.7	48.1	47.6	146.4
15	50.7	50.5	51.8	153.0
16	48.3	45.3	47.8	141.5
17	51.5	51.5	53.1	156.0
18	54.3	55.2	57.9	167.4
19	46.2	47.3	49.7	143.1
20	48.3	49.1	52.1	149.4
21	48.8	51.8	51.2	151.8
22	46.9	47.4	46.9	141.1
23	52.9	55.0	52.9	160.8
24	51.2	51.1	48.7	151.0
25	48.8	49.8	49.8	148.3
26	53.3	54.0	54.2	161.6
27	48.7	48.6	49.6	146.9

*Numbers are rounded; therefore total need not be the sum of English, reading and numerical scores.

TABLE 4. MEAN STANDARD SCORES FOR SOPHOMORE STUDENTS BY SCHOOL.

School Number	English	Reading	Numerical	Total*
1	47.0	48.0	53.6	148.6
2	47.5	47.2	49.9	144.6
3	54.4	56.0	55.8	166.2
4	51.7	51.7	54.2	157.5
5	47.6	48.0	48.2	143.8
6	54.8	51.1	53.7	159.6
7	48.4	46.2	49.3	143.8
8	50.6	46.1	48.6	145.3
9	50.4	49.8	50.8	151.0
10	48.9	46.3	50.3	145.5
11	51.5	53.9	54.5	159.9
12	52.5	53.2	55.4	161.1
13	47.7	49.6	50.3	147.5
14	55.1	53.0	54.7	162.8
15	47.7	48.1	47.8	143.7
16	51.7	49.8	50.5	151.9
17	51.7	51.9	52.0	155.6
18	54.8	54.4	56.4	165.6
19	49.7	50.7	51.2	151.6
20	48.6	46.8	50.2	145.5
21	51.8	50.0	52.0	153.8
22	53.1	51.7	50.9	155.7
23	55.6	56.3	55.8	167.7
24	52.3	52.5	51.2	156.0
25	52.9	50.3	51.8	155.0
26	57.2	57.7	57.0	172.0
27	49.3	50.8	50.2	150.2

*Numbers are rounded; therefore total need not be the sum of English, reading and numerical scores.

TABLE 5. STANDARDIZED TEST MEANS RANKED FROM HIGHEST TO LOWEST FOR SENIOR STUDENTS SHOWING SCHOOL NUMBER.

English		Reading		Numerical Competency		Total*	
Mean Score	School Number	Mean Score	School Number	Mean Score	School Number	Mean Score	School Number
57.8	9	57.6	9	57.9	6	172.4	9
56.8	11	57.4	11	57.9	18	167.9	3
56.6	3	55.2	3	56.9	9	167.8	11
55.6	8	55.2	18	56.2	3	167.4	18
54.3	18	55.0	23	54.2	26	162.1	6
53.3	26	54.0	26	53.7	11	161.6	26
52.9	23	53.4	12	53.4	12	160.8	23
52.8	6	52.4	8	53.1	17	160.1	8
51.5	17	51.8	21	52.9	23	157.6	12
51.2	24	51.5	17	52.8	2	155.0	17
50.8	12	51.4	6	52.1	8	153.2	2
50.7	15	51.1	24	52.1	20	153.0	15
50.7	14	50.5	15	51.8	15	151.8	21
50.4	5	50.5	2	51.2	21	151.0	24
50.0	2	50.4	5	50.3	4	150.2	5
49.6	4	49.8	25	49.8	25	149.4	20
48.8	25	49.1	20	49.7	19	148.5	4
48.8	21	48.8	13	49.6	27	148.3	25
48.7	27	48.6	27	49.5	5	146.9	27
48.3	16	48.5	4	48.7	24	146.4	14
48.3	20	48.1	14	47.8	16	143.1	19
46.9	22	47.4	22	47.6	14	142.2	13
46.4	1	47.3	19	47.1	13	141.5	16
46.3	13	45.3	16	46.9	22	141.1	22
46.2	19	44.6	1	46.6	1	137.6	1
45.5	7	44.1	10	45.4	7	133.2	10
44.6	10	42.0	7	44.5	10	133.0	7

*Numbers are rounded; therefore total need not be the sum of English, reading and numerical scores.

TABLE 6. STANDARDIZED TEST MEANS RANKED FROM HIGHEST TO LOWEST FOR SOPHOMORES SHOWING SCHOOL NUMBER.

English		Reading		Numerical Competency		Total*	
Mean Score	School Number	Mean Score	School Number	Mean Score	School Number	Mean Score	School Number
57.2	26	57.7	26	57.0	26	172.0	26
55.6	23	56.3	23	56.4	18	167.7	23
55.1	14	56.0	3	55.8	3	166.2	3
54.8	6	54.4	18	55.8	23	165.6	18
54.8	18	53.9	11	55.4	12	162.8	14
54.4	3	53.2	12	54.7	14	161.1	12
53.1	22	53.0	14	54.5	11	159.9	11
52.9	25	52.5	24	54.2	4	159.6	6
52.5	12	51.9	17	53.7	6	157.5	4
52.3	24	51.7	22	53.6	1	156.0	24
51.8	21	51.7	4	52.0	17	155.7	22
51.7	4	51.1	6	52.0	21	155.6	17
51.7	17	50.8	27	51.8	25	155.0	25
51.7	16	50.7	19	51.2	19	153.8	21
51.5	11	50.3	25	51.2	24	151.9	16
50.6	8	50.0	21	50.9	22	151.6	19
50.4	9	49.8	16	50.8	9	151.0	9
49.7	19	49.8	9	50.5	16	150.2	27
49.3	27	49.6	13	50.3	10	148.6	1
48.9	10	48.1	15	50.3	13	147.5	13
48.6	20	48.0	1	50.2	20	145.5	10
48.4	7	48.0	5	50.2	27	145.5	20
47.7	15	47.2	2	49.9	2	145.3	8
47.7	13	46.8	20	49.3	7	144.6	2
47.6	5	46.3	10	48.6	8	143.8	5
47.5	2	46.2	7	48.2	5	143.8	7
47.0	1	46.1	8	47.8	15	143.7	15

*Numbers rounded; therefore total need not be the sum of English, reading and numerical scores.

TABLE 7. SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE TESTING MEAN DIFFERENCES OF STANDARDIZED TEST SCORES FOR SOPHOMORES.

	Mean	F-Value
English	51.21	4.94184*
Reading	50.82	4.73768*
Numerical Competency	51.65	4.51740*
TOTAL SCORE	153.68	5.49332*

*Significant at the 1 percent level.

TABLE 8. SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE TESTING MEAN DIFFERENCES OF STANDARDIZED TEST SCORES FOR SENIORS.

	Mean	F-Value
English	50.15	3.42452*
Reading	50.23	3.47331*
Numerical Competency	50.95	4.03208*
TOTAL SCORE	151.33	4.06610*

*Significant at the 1 percent level.

Effects of School Size

Tables 9 and 10 show the mean score that the seniors and sophomores obtained on each test. The composite mean and the number of students sampled in each size classification are also shown. The results of an analysis of variance test among the mean differences for the seniors appear in Table 11 by test area. Table 12 contains the same information for the sophomores.

The mean scores by four school size classes shown in Table 9 are very closely grouped. The results of the analysis of variance test indicate that the F-value for the numerical competency test was significant at the .01 level (Table 11). However, when total composite mean scores are analyzed, no statistical difference was apparent in the achievement levels of seniors from different size schools. The seven smallest schools had the highest mean of all the schools in the numerical competency test and in the total mean score. The six largest schools, size class four, had the lowest total score. Size class two had the high mean score in English and reading while size class three ranked lowest in these two areas.

Table 10 shows that in size class four, sophomores in the six largest schools scored highest in all of the three areas tested and in total score. The seven smallest schools ranked low in English and read-

ing and class three schools scored low in numerical competency. Analysis of variance revealed a significant F-value only in the total score (Table 12). Hence, these data suggest that there are significant differences between the performance of sophomores from large and small high schools with respect to composite scores on the three SAT tests.

TABLE 9. STANDARDIZED TEST MEANS FOR SENIORS BY SCHOOL SIZE.

Size Class	Number of Students	School Size	English	Reading	Numerical	Total*
1	124	0—118	50.9	49.9	52.0	152.7
2	165	119—261	50.9	51.0	50.0	151.9
3	386	262—1040	49.6	49.9	51.6	151.1
4	200	1041 and over	50.1	50.6	49.8	150.5
		All Schools	50.1	50.2	50.9	151.3

*Numbers are rounded; therefore total need not be the sum of English, reading and numerical scores.

TABLE 10. STANDARDIZED TEST MEANS FOR SOPHOMORES BY SCHOOL SIZE.

Size Class	Number of Students	School Size	English	Reading	Numerical	Total*
1	132	0—118	50.2	49.7	52.1	152.0
2	265	119—261	51.0	50.2	52.1	153.3
3	584	262—1040	50.8	50.2	51.5	152.5
4	330	1041 and over	53.4	53.2	53.8	159.4
		All Schools	51.2	50.8	51.7	153.7

*Numbers are rounded; therefore total need not be the sum of English, reading and numerical scores.

TABLE 11. SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE TESTING MEAN DIFFERENCES BY SCHOOL SIZE FOR SENIORS.

	Mean	F-Value
English	50.1	1.02760
Reading	50.2	0.60365
Numerical Competency	50.9	2.55672*
TOTAL SCORE	151.3	0.24479

*Significant at the 1 percent level.

TABLE 12. SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE TESTING MEAN DIFFERENCES BY SCHOOL SIZE FOR SOPHOMORES.

	Mean	F-Value
English	51.2	1.60483
Reading	50.8	1.83860
Numerical Competency	51.7	0.62460
TOTAL SCORE	153.7	2.47970*

*Significant at the 1 percent level.

Comparing Scores to Stanford Achievement Test Norms

Tables 13 and 14 include comparisons of the mean scores of the students to the percentile and stanine rankings provided by the Stanford Achievement Test (SAT). Table 13 shows the raw mean in each test converted to the SAT standard score, which can be placed in stanine and percentile rankings. All of the mean scores are in the fifth stanine which indicates average performance. Whereas the mean achieved by sophomores placed them equal to or greater than 50 percent of other students in their group in each test area, seniors ranked at the forty-fourth percentile in English, the forty-eighth percentile in numerical competency, and fifty-fourth percentile in reading. This is not quite as high as the sophomores.

Table 14 shows the percentage of sophomores and seniors whose scores fell below the fifth stanine by subject area and grade level. The smallest schools ranked highest in English and numerical competency and lowest in reading for seniors. Class three schools ranked worst in English and class four schools performed lowest in numerical competency and highest in reading for seniors. Sophomores ranked fairly well in all areas, but the largest size class ranked best in all tests. The smallest schools ranked lowest in reading and class three schools ranked lowest in English and numerical competency.

Sophomores in the large school systems do seem to rank better than those in the other three size classifications, but at the senior level there doesn't seem to be a significant difference in the ranking by school size.

TABLE 13. AVERAGE RAW SCORES FOR SOPHOMORES AND SENIORS (ALL STUDENTS).

	Raw Mean	SAT Conversion		
		Standard	Stanine	Percentile
Sophomore				
English	53.3	49	5	50
Numerical Competency	28.2	50	5	52
Reading	36.6	50	5	50
Senior				
English	59.7	53	5	44
Numerical Competency	31.0	53	5	48
Reading	42.1	54	5	54

TABLE 14. PERCENTAGE OF STUDENTS BELOW THE FIFTH STANINE ON EACH TEST BY SIZE AND TOTAL.

Class Size	Students				
	1	2	3	4	All
English	Percent				
Sophomores	23	23	27	12	21
Seniors	33	38	43	38	39
Numerical Competency					
Sophomores	19	20	25	17	21
Seniors	37	42	39	47	41
Reading					
Sophomores	31	28	29	16	25
Seniors	54	49	47	44	48

Determinates of Achievement

A limited amount of socio-economic data was collected on each student to identify factors related to achievement. In addition, information was gathered on the students' community, school and home. Variables regressed against achievement are school attitude, expenditures per student, school size, father's education, items at home, reading material, number of cars owned by the family, own room and car, college intention, school activities, and hours worked outside of school. Analyses were run with and without an additional variable — grade point average.

Scores in English, reading and numerical competency were used as measures of school output, the dependent variables. Results of these analyses are summarized for senior students in Table 15 and by school size in Table 16. Coeffici-

ents of determination (R^2) and significance tests (F-Value) are shown for each dependent variable. Results of Table 15 indicate that the independent variables explain 47 percent of the variance in total student achievement when GPA is included as an independent variable. In Table 16, R^2 varies by school size. All regression equations showed marked differences of significant variables by school size.[3]

Regression coefficients and F-values for two of the regression equations are shown in Tables 17 and 18. The composite achievement test score for senior students was used as the dependent variable in both equations shown. The independent variables are presented along with the pertinent data on each. Both tables show the "F" statistic testing the hypothesis of the regression coefficient being zero as well as the regression coefficient. The regression coefficient represents numerically the effect that one unit increase in the independent variable has upon the dependent variable. A "Beta" value is also used to describe the independent variables. The Beta coefficient describes the results of one standard deviation increase in the independent variable on the dependent variable. For example, if the Beta coefficient was .5 then an increase of one standard deviation in the independent variable would cause the dependent variable to increase .5 of its standard deviation.

[3]See "Educational Achievement In Rural Montana High Schools," by John W. Kimble, Unpublished Masters Thesis, Montana State University, December 1974

Grade point average (GPA), included as an independent variable in Table 17, has the largest Beta value, also the F-value for GPA is significant at the .05 level. From these data, higher GPA correlates positively with higher achievement. The student's plans for college has the next highest Beta value. This also correlated positively with achievement as was expected since the student with college intentions probably has a more positive attitude towards learning and school. The third highest Beta value was for per student expenditures. The negative relationship indicates that the more spent per student the lower the achievement. This may be a result of high costs per student in small schools.

The student's involvement in school activities, such as student government and athletics, had the next highest Beta value and also revealed a positive relationship to achievement. This was closely followed by high Beta values related to school attitude and reading material in the home. Both also had positive relationships to achievement. All of the above variables were significant at the .05 level. Two other variables were significant at the .10 level. They were father's educational level and the number of cars in the family; both of which showed positive relationships to achievement. Insignificant variables in the equation were school size, items in the home, whether or not the student had their own room and car, and hours working on an outside job.

Table 18 contains the total score equation for all students without grade point average as an

independent variable. The highest Beta value was for college intentions which had a positive relationship to achievement. The next highest Beta value was related to involvement in school activities and this also revealed a positive relationship. The third highest Beta value was obtained by the school attitude variable followed in order by: per student expenditures, student's own room and car, father's educational level, reading material in the home, and hours work on a job outside of school. Three of the variables had a negative relationship to achievement. These were per student expenditures, own room and car, and hours spent on an outside job. All of the variables mentioned here were significant at the .05 level. Three variables in the equation were not significant at the .05 level; these were school size, items in the home, and cars in the family.

The variables in this study seem to be better predictors for the two intermediate school sizes which range from 119 to 1,040 students than for the largest and smallest schools. Most of the variance can be attributed to factors other than those represented in the equations. Data indicate that the independent variables used do affect student achievement. The largest R^2 value was obtained by schools with 262-1,040 students. Schools of less than 118 students achieved the smallest R^2 value. When grade point average was included as an independent variable in the equation, it showed the highest correlation of all the variables to achievement in each instance. However, GPA may be dependent on items such as student motivation, student's intelligence, and parental attitudes.

The student's attitude toward school showed a positive relationship for all students. In cases where it was related to achievement by school size, its relationship varied in that it was not always a significant variable.

Per student expenditure was not always a significant variable and when it was significant it showed a negative relationship to achievement.

School size was not significant in most cases either. It showed significance only in the school of size 119-261 student population and then only if GPA was not an independent variable. Its relationship in these cases is positive.

Fathers' education showed significance only when viewed for all students and in larger schools. This may be a result of lower education levels in rural areas. Its relationship is positive. Fathers' education level is used as a proxy for the socio-economic status of the family. It was felt to be the best predictor based on other studies and upon its relationship in these equations when compared to a socio-economic index or the mother's educational level.

Items in the home show significance only in some of the size classifications. It shows a positive relationship to achievement.

Reading material has a positive relationship in all cases where it showed significance. It did not seem related in the smaller more rural schools.

The number of cars in the family was used as an indicator of economic status. It was significantly related in only three cases and two of those are at the 10 percent level of significance. Its relationship, when significant, was positive.

Whether or not the student has his own room and car shows significance in some cases. The relationship to achievement was negative in these cases.

The college intentions of students was significant in most cases. Only in the two smallest school size classifications did it not show significance and then only if GPA was not an independent variable. Its relationship in each case was positive.

The student's involvement in school activities was important in almost all cases. It shows a positive relationship to achievement where it was significant. In the larger school classes it was not as consistently significant.

The amount of time a student spent working at an outside job was significant in three cases when looking at the total score equations. This relationship in all instances was negative.

The equations do show marked differences of significant variables by school size. The importance of the common variables in these cases shows some variation as well. In all equations the only items that show up consistently are GPA, some home items, and per student expenditures. Not in all cases was per student expenditure a positive relationship for the individual tests. This also varies by school size.

TABLE 15. DEPENDENT VARIABLES (SUMMARY FOR SENIOR STUDENTS).

Dependent Variable	R^2	F-Value
Reading: with GPA	.38905	45.74249
without GPA	.23331	23.87464
English: with GPA	.38719	45.38680
without GPA	.21445	21.41803
Numerical Competency: with GPA	.36805	41.83678
without GPA	.19891	19.48079
Total: with GPA	.47275	64.40821
without GPA	.26271	27.95540

TABLE 16. DEPENDENT VARIABLES (SUMMARY BY SCHOOL SIZE).

School Size	With GPA		Without GPA	
	R^2	F-Value	R^2	F-Value
0-118				
Reading	.33806	4.72407	.24444	3.29402
English	.35948	5.19146	.20822	2.67763
Numerical Competency	.36763	5.37744	.20866	2.68481
Total	.42914	6.95350	.25909	3.56045
119-261				
Reading	.44339	10.09017	.27256	5.21141
English	.44993	10.36087	.30156	6.00541
Numerical Competency	.42926	9.52671	.25837	4.84567
Total	.53659	14.66676	.32950	6.83535
262-1,040				
Reading	.48843	29.67770	.30964	15.24968
English	.49170	30.06809	.27406	12.83561
Numerical Competency	.40500	40.34411	.24638	11.11548
Total	.56483	40.34411	.33247	16.93422
1,041 and over				
Reading	.46196	13.37995	.26237	6.07897
English	.45175	12.84053	.23459	5.23812
Numerical Competency	.42838	11.67834	.18265	3.81936
Total	.52943	17.53228	.25577	5.87365

TABLE 17. TOTAL SCORE EQUATION FOR SENIOR STUDENTS WITH GPA AS AN INDEPENDENT VARIABLE.

Dependent Variable	Independent Variables	Regression Coefficient	F-Value
Total Score	GPA	18.40740	343.288*
	School attitude	2.89286	3.935*
	Per student expenditure	-0.00238	11.034*
	School size	-0.00082	0.455
	Father's education	0.29627	3.419**
	Items at home	8.89239	1.856
	Reading material	0.08537	5.238*
	Cars in family	0.81256	2.812**
	Own room and car	-2.82010	1.910
	College intention	8.25217	30.921*
	School activities	5.85408	5.265*
	Hours worked	-0.04515	0.902
	Constant	92.21983	
	R^2 = .47275	F-value =	64.40821*

*Significant at the 5 percent level.
**Significant at the 10 percent level.

TABLE 18. TOTAL SCORE EQUATION FOR ALL STUDENTS WITHOUT GPA AS AN INDEPENDENT VARIABLE.

Dependent Variable	Independent Variable	Regression Coefficient	F-Value
Total Score	School attitude	6.89409	16.358*
	Per student expenditure	-0.00285	11.309*
	School size	0.00049	0.115
	Father's education	0.41821	4.885*
	Items at home	10.58202	1.882
	Reading material	0.08751	3.941*
	Cars in family	0.83606	2.131
	Own room and car	-5.18910	4.649*
	College intentions	15.80306	87.807*
	School activities	14.51858	23.989*
	Hours worked	-0.14737	6.975*
	Constant	128.84119	
	R^2 = .26271	F-value =	27.9554*

*Significant at the 5 percent level.

Summary and Conclusions

The study had two major objectives:

1) to analyze whether or not school size is important in determining student achievement, and

2) to analyze factors that affect student achievement and to determine whether or not these factors vary in different size schools.

Major steps in accomplishing the objectives were as follows: First, samples of schools and students were taken with the aid of the Mathematics Department at Montana State University. Time and money limited the sample to less than 10 percent of the sophomores (grade 10) and 10 percent of the seniors (grade 12) in the state. Out of approximately 50,000 high schools students in Montana, 2,186 were tested, including 1,311 sophomores and 875 seniors. The second step was to design the necessary collection instruments and select an achievement test. The Stanford Achievement Test (SAT) was chosen on a basis of price, availability and a recommendation of Buros (1972). Third, each school was visited and the students were tested by the data collectors hired for the project. In the fourth step the data were verified, checked and coded for input into the computer. The analysis utilized packages by Lund (1973) and a system called SPSS (Nie, 1970). Analysis of variance and regression analysis were the two major statistical techniques used in the analysis. Finally, the data collected were analyzed in light of the project objectives.

The first of the objectives was to analyze whether or not

school size is important in determining student achievement. The mean score of each test was calculated for each school. This score was standardized so that a composite total score might also be calculated. This procedure was the same for both sophomores and seniors.

The mean scores for each test for the seniors were ranked from highest to lowest and an analysis of variance procedure was used to test mean differences. The range of the means was about 13 points for English, 15 points for reading, 13 points for numerical competency, and 39 points for the composite total score. The analysis of variance procedure showed a significant difference at the .05 level of significance. Thus, the conclusion that a significant difference does exist between the highest and lowest mean but no other comparison could be made with the methods used in the study. A comparison of the means by school size was also made. In this case the analysis of variance procedure showed a significant difference only in the case of numerical competency. The ranges of means in all test scores by school size was less than three points. On the basis of the statistical analysis applied, no significant difference could be determined.

The same procedures were used on the mean scores for each test given to the sophomores. The analysis of variance showed a difference in total mean scores by school size at the .05 level of significance.

When the mean scores were ranked from highest to lowest the ranges of the means were about 11 points for the English test and the reading test, 9 points on the numerical competency test, and 29 points for the total score. A comparison of the means for each size classification showed differences in the mean scores. In each of these cases the highest mean was for large schools and the lowest mean was for small schools.

Based on these results it seems reasonable to conclude that at the senior level in high school no significant differences exist in the mean test scores based on size of the school. This is not true at the sophomore level of high school. The sophomores of the larger high schools do seem to score better on achievement tests than do those from the smaller rural schools. When the means of the individual schools are compared, the seniors' achievement is fairly evenly interspersed throughout rural and urban schools. Ranking of the schools by sophomore mean score seems to place more urban schools than rural scores at the top of the scale.

A comparison of test scores to SAT norms reveals interesting results. The means of the seniors and sophomores in every test fell in the fifth stanine ranking, which is average for all students taking the test. Percentages of students below the fifth stanine by school size showed only one group with more than 50 percent of the students at the fourth stanine or below. In schools with less than 118 students in size, 54 percent of the seniors tested fell at the fourth stanine or below. In each test administered and for each school size the seniors placed a larger percent-

age of students below the fifth stanine than did the sophomores.

From the results, however, it seems that Montana students on the whole do fairly well when compared to the national performance statistics on this particular achievement test. Sophomores compare favorably and seniors place about average. Sophomores in the largest schools place better than do sophomores in the other three size classifications. Seniors do not seem to vary much from one size class to another.

The second objective was to analyze factors that affect student achievement and to determine whether or not these factors vary in different size schools. Regression analysis was used to analyze the data for this objective. Twelve variables were chosen to represent the school, the student, and the students' socio-economic status. The independent variables were regressed against each of the dependent variables for each of the four school size categories and for all students sampled.

The regression for all senior students as a group show GPA, school attitude, per student expenditure, reading material in the home, college intentions, and extracurricular school activities to be the most important variables in determining student achievement. School size was not a significant variable. When GPA was dropped as a variable three other variables—father's education, own room and car, and number of hours the student worked at a job became significant. In both cases per student expenditures had a negative effect on achievement. It appears that student measures such as GPA, school attitude, and socio-economic measures such as reading material and college intentions have the strongest effect on student achievement.

Analysis of the equations for the different size schools strongly suggests that the factors differ in their relationship to student achievement. In the smallest rural schools only two variables are strongly significant, GPA and cars in the family. When GPA was omitted as a variable, college intentions and extracurricular school activities became significant. The largest size class equation shows four significant variables, GPA, per student expenditures, items in the home, and college intentions. Omitting GPA changes the influence of the father's educational level. Per student expenditure has a negative effect on achievement in both equations. The other two size classes show much stronger relationships to the variables. Only in schools of size 119-261 students is school size a significant variable. In schools of 262-1,040 students, neither school size nor per student expenditures are significant. Hours worked at an outside job show a negative relationship to achievement in this size school.

The variables do seem to vary in their relationship according to school size. The rural schools seem to have different variables influencing student achievement than the larger urban schools. Socio-economic backgrounds of the students seem to have the most influence on achievement. There does seem to be a relationship be-

tween school inputs and socio-economic status. Both affect achievement.

This study does not provide an answer to the problems of school productivity. It does suggest that there is something more to increasing output quality than increasing funding. It does support some ideas that different schools of the same size may have to spend different amounts to maintain achievement at a consistent level. There are variables beyond the control of the school system that affect student achievement which must be taken into consideration in estimating a school production function.

The findings highlight the need for continuous efforts to specify the relevant outputs of the educational system as well as the optimum input levels. Such information is crucial to good decision making with respect to human resource development.

The findings of this study suggest additional research which lies beyond the capabilities of the present data. The effects of school inputs on social backgrounds and the production functions of school administrators with emphasis on budget constraints and legal responsibilities warrant further investigation. A definitive measure of achievement might be gained by testing the student on entrance and exit from the school to obtain the differences in achievement. Other measures of achievement should be considered; student self-concept, enrichment programs and physical development are examples. A more definitive view of the effects of schools in the education process is needed. A number of production functions should be considered simultaneously rather than as a single equation.

In conclusion, the rural student seems to do about as well as the urban student, yet the variables influencing achievement differ for the rural student. The results may indicate possible policy implications. The lack of differences in achievement between large and small schools opens areas for school consolidation. If no significant difference in achievement is evident, economies of scale might be accomplished through school consolidation. The acceptance of the idea that different combinations of inputs are required for different schools may have implications in the area of school finance. If a school, to achieve a desired level of achievement must use input factors that are more capital-intensive than a school of equal size, then equal educational opportunity is not achieved through equal expenditures.

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